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E SCALE DAIRY OPERATIONS IN WEST VIRGINIA, 1970

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WEST VIRGINIA UNIVERSITY • AGRICULTURAL EXPERIMENT STATION

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SUMMARY

For purposes of this study, large scale dairy operations were defined as having 100 or more dairy cows. Using several means of inquiry, all herds thought to fit the definition of "large scale" were located and the operators interviewed. Excluding institutional herds, there were 40 such dairy herds in West Virginia during 1970. Most of these herds were located along the borders of West Virginia. Two factors, market conditions and topography, probably dictate the border locations.

The operations averaged 793 acres with a range from 190 acres to 1,675 total acres. Forty-one per cent of the land was used for cropping purposes and about one-third of the cropland was rented. The operations averaged producing 94 acres of corn grain, 95 acres of corn silage, and 113 acres of hay. Average crop yields per acre reported were: 21 tons of corn silage, 99 bushels of corn grain, 56 bushels of oats, 72 bushels of barley, 38 bushels of wheat, and four tons of hay.

The average herd size was 134 milking cows, and the largest herd had 325 cows. The average milk production per cow reported was 12,486 pounds per year and ranged from a herd average per cow of 10,000 to 16,200 pounds.

Eighty per cent of the operators reported using artificial insemination for their herds. However, nearly three-fourths of the operations reported having bulls which were kept mostly for breeding first-calf heifers. Nearly all operators kept 90 per cent or more of their heifer calves for herd replacements. Thirty per cent of the operators raised some of their male calves as steers. The average calf death loss was 6.7 per cent per year. Most operators believe it is cheaper and that better quality replacements are obtained by raising their own calves rather than by purchasing replacement animals. The operators estimated the 1970 average replacement cost for a heifer equal in quality to those that they raised to be \$430.

Five dry lot operations were reported, with the remaining operators reporting their milking herds pastured for at least two months during the early pasture season. Other management practices varied somewhat by seasons. Concentrate feeding per milking cow averaged 17 pounds per day. Milking cows received an average of 44 pounds of corn silage and 10 pounds of hay per cow per day during the seasons that these feeds were fed to the milking cows.

The herringbone parlor was the most popular type of milking facility. Forty per cent of the herringbone facilities was double-six parlors. The average milking crew consisted of two men. Each man used an average of 2.6 milking units and the two-man crew averaged milking 215 cows daily. Bulk milk storage was utilized on each farm and the most common bulk tanks had a minimum storage capacity of 1,000 gallons.

Two-thirds of the milking herds were housed in free stall barns. Straw and sawdust were the principal bedding materials. The operations averaged over four silos per farm. Each silo had an average storage capacity of 358 tons of silage.

Mechanization of operations on dairy farms of this scale is important from the standpoint of economics of production and timeliness of operation. Most of the tractors and equipment were less than five years of age. The 40 operators reported owning a total of 205 tractors ranging in size from 11 to 111 horsepower per tractor.

Typically, the labor force on the large dairy operations consisted of an owner or operator, family members, and two or three full-time hired men. One operation depended entirely upon family labor, while another operation reported nine full-time hired men. The average operator was 44 years old and 80 per cent of the operators had at least a high school education.

In the opinion of the operators, labor was the most limiting factor in the operation of their businesses. Land, capital, and management followed in that order as the next most limiting factors.

Although capital was reported as a limiting resource, it did not appear to be particularly difficult to obtain. The principal credit sources were: Production Credit Association, Farmers Home Administration, Federal Land Bank Association, and insurance companies. Reported indebtedness ranged from \$10,000 to more than \$150,000. Total assets reported ranged from \$100,000 to over \$500,000.

THE AUTHORS

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Large Scale Dairy Operations In West Virginia, 1970

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and
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Dairying is a very complex and rapidly changing industry. Technical innovations, increased production, and additional cost have resulted in fewer dairy operations with more cows per operation. The modern dairyman has been forced into becoming larger and more efficient, accepting low returns, or quitting the dairy business. If large scale dairying is to be the future trend, the future dairyman of West Virginia will have to accept the challenge. This resource study could serve as a guide for expansion of West Virginia's dairy operations.

PROBLEM

Results of a study recently completed by Layton, Nesselroad, and Barr of farm plans for eastern West Virginia livestock farms indicate that West Virginia could possibly be a dairying frontier.¹ Dairying proved to be the most profitable use of available resources for any of the livestock alternatives considered, according to their linear programming analysis. The optimum plans including the dairy enterprise had net incomes that ranged from \$6,400 to \$10,000 higher for small farms and from \$12,000 to \$17,600 higher for large farms than was obtained in the next most profitable plans.²

The 1968 gross income from dairy products of \$24,969,000 ranked number one compared with other agricultural enterprises in West Virginia.³ Income from cattle and calves ranked second with a gross income of \$23,965,000.⁴ The gross income attributable to dairying would be higher if the value of dairy animals, culls, and calves were separated from the sale value of all cattle and calves and added to the value of dairy products.

¹Ronald A. Layton, Paul E. Nesselroad, and Alfred L. Barr, *Alternative Farm Plans for Eastern West Virginia Livestock Farms*, West Virginia Agricultural Experiment Station Bull. 597T, Morgantown: West Virginia University, February 1971, p. 21.

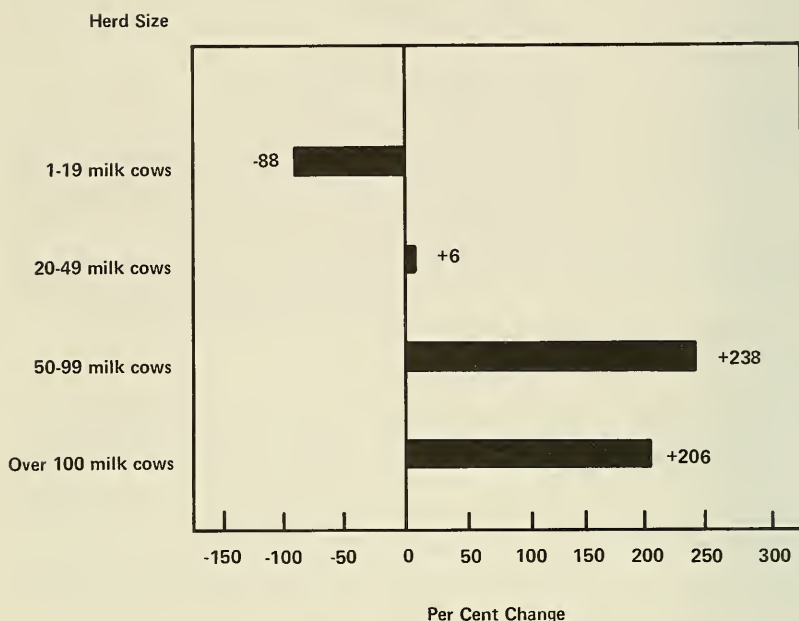
²*Ibid.*

³West Virginia Department of Agriculture, West Virginia Crop Reporting Service, *West Virginia Agricultural Statistics, 1969*, C. R. Bulletin No. 8 (Charleston: West Virginia Department of Agriculture, 1969), p. 3.

⁴*Ibid.*

FIGURE 1

PERCENTAGE CHANGE IN NUMBER OF FARMS
REPORTING MILK COWS BY SIZE OF HERD,
1950-1969



Source: National Milk Producers Federation, *Dairy Producer Highlights*, 1972 (Washington: National Milk Producers Federation, 1972), p. 5.

The size of dairy herds throughout the nation has increased rapidly in the past 20 years. (Figure 1). The herds of 50 to 99 cows have increased 238 per cent, and those herds over 100 cows have increased 206 per cent; herds of less than 20 cows have shown large percentage declines.⁵ A growth pattern of this type in the future means fewer but larger dairy operations. If large scale dairying in West Virginia is to reach its greatest potential, information about resources currently committed and practices currently being employed by large scale dairy operators should be available for decision making. Thus, a study determining the use of available resources on large dairy herds of 100 or more cows provides a guideline for West Virginia dairymen to initiate changes or to increase the size of their dairy operations.

⁵ National Milk Producers Federation, *Dairy Producer Highlights*, 1972 (Washington: National Milk Producers Federation, 1972), p. 5.

OBJECTIVES OF THE STUDY

The major objective of the study was to report information that might serve as a guide for dairymen who are faced with problems of organization and expansion of a large dairy operation.

More explicitly, the study was designed to:

1. Determine the present use of land resources.
2. Determine the number of dairy cattle and feeding practices presently used.
3. Determine the kinds of buildings and equipment used.
4. Provide information on organization, growth, and development.

PROCEDURE, ASSUMPTIONS, AND DEFINITIONS

The procedure followed in this study was to locate all the dairy herds in the State with 50 or more dairy cows. Once the sizes and numbers of such herds were known they were sorted into various herd size classes. Based upon herd size and the number of herds in the various classes a so-called large scale dairy operation was arbitrarily defined. The operators of these large scale dairies were individually contacted and interviewed.

From various sources, it was learned and accepted that the State had approximately 180 dairy herds in 1970 with herd sizes ranging from 50 to 75 cows, 75 herds having from 76 to 99 cows, and 40 dairy herds with 100 or more dairy cows. The approximate locations of the dairy herds with 100 or more cows are shown in Figure 2.

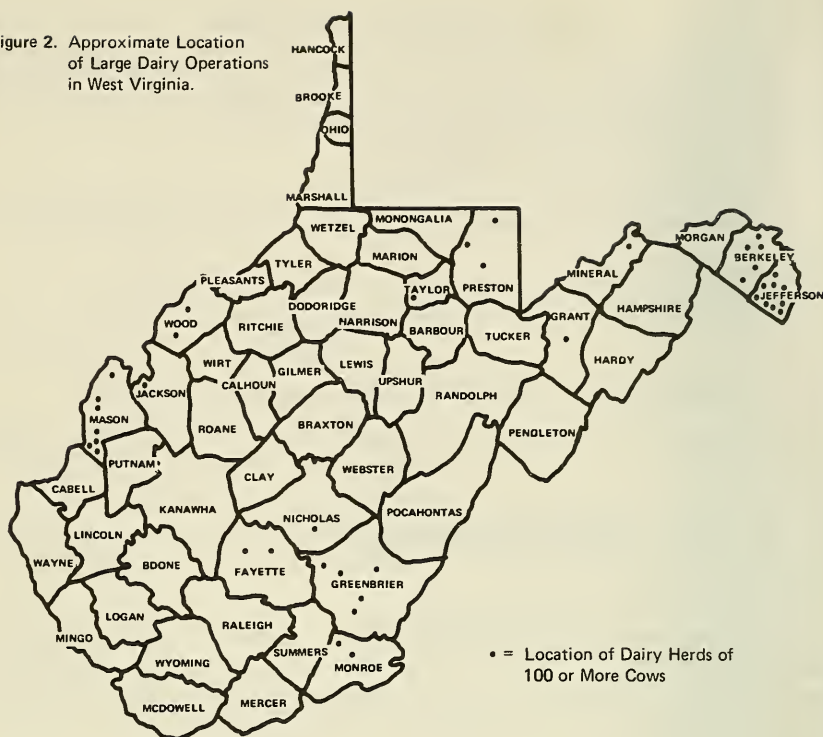
The minimum requirement for a large dairy operation was arbitrarily set at 100 cows, milking and dry, in the herd. A 100-cow operation was not eliminated from the study if a recent unforeseen misfortune had reduced the herd size below that figure. However, these dairy operations had to be rebuilding toward their original herd size. *Institutional dairy operations were excluded in the study.*

Throughout this report, the use of the word "large" as used in the expression "large dairy operation" means a herd of 100 or more dairy cows. The word "operation" was used in place of "farm" because all the production factors—land, labor, capital, and management—were considered in the study. When a particular factor of the operation is being discussed, it will be referred to as a certain "phase" of the operation.

DESCRIPTION OF AREA

Dairy operations in 13 different counties were included in the study. Since the study dealt only with large dairy operations in West Virginia, the study area theoretically included the entire State. However, several counties in the

Figure 2. Approximate Location of Large Dairy Operations in West Virginia.



southwestern section of the State were not truly part of the study area since they possess very limited potential for large scale dairy operations. Ten out of 13 counties in the study bordered the states of Ohio, Virginia, Pennsylvania, and Maryland. The counties that had one or more large operations were: Berkeley, Fayette, Grant, Greenbrier, Jackson, Jefferson, Mason, Mineral, Monroe, Nicholas, Preston, Taylor, and Wood.

LITERATURE REVIEW

Studies of large scale dairy operations have been conducted at several universities.⁶ These studies were written for the purpose of providing infor-

⁶ James S. Holt and W. L. Barr, *Large Pennsylvania Dairy Farms*, Pennsylvania Agricultural Experiment Station, Progress Report 237, University Park: The Pennsylvania State University, April, 1962; N. D. Kimball, *Costs and Returns for Large Wisconsin Dairy Herds*, Wisconsin Agricultural Experiment Station, Bulletin 579, Madison: University of Wisconsin, April, 1966; Raymond H. Tremblay, *Large Dairy Farms in Vermont*, Vermont Agricultural Experiment Station, Bulletin 643, Burlington: University of Vermont, March, 1966; and John W. Wysong, *Economics of Large Size in the Production of Fluid Milk on Specialized Dairy Farms in Maryland*, Maryland Agricultural Experiment Station, Misc. Publication No. 544, College Park: University of Maryland, March, 1965.

mation on dairy resource availability and use. No formal statistical tests were used to analyze the data. Instead, the data were presented in various tabular forms. Tabular analysis in resource studies presents the data in its most readable form. Contents of these studies include:

1. description of the farm structure
2. land use
3. labor
4. housing and milk facilities
5. management practices

Financial returns, factors affecting returns, and major problems affecting large dairy operations were additional items of discussion.

These studies were conducted in the early 1960's. At this time dairymen were realizing that herds of 20 to 30 cows were not as competitive as larger herds. Larger herds were needed to overcome greater fixed and variable costs. The budgeting in these studies was done comparing various herd sizes.

LAND RESOURCES

All 40 of the large scale dairy operators cooperated in providing the information contained in this report. In the early analysis of the data, the operators' responses were tabulated on resource areas of the State, which in turn are based primarily upon broad, general land characteristics. This initial distribution provided the basis for a decision that the farms, though scattered, were not materially different and the analysis thereafter was made on an aggregate approach rather than on area approaches.

The items compared on the area approach are presented in Table 1. The only items for which large differences between areas existed were total animal units and animal units per man equivalent. Hereinafter the data and comparisons are made as averages, ranges, or percentages for the total 40 operations.

Total Land Acreage

Land resources were classified on the basis of land use such as cropland, pasture, brush and timber, and other land. The operations averaged 793 acres (Table 2). Average acreages of various land uses included 324 acres of land in crops, 58 acres of cropland pasture, 311 acres of permanent pasture, 137 acres of brush and timber, and 34 acres of all other land. Only 12 operators reported acreages of cropland pasture and 31 reported having brush and timber. The smallest operation had 190 acres and the largest 1,675 acres.

A further analysis of land resources showed 41 per cent of the total acreage was cropland and 39 per cent was permanent pasture. Thus, for approximately every acre of cropland, there is about an acre of permanent pasture. One-third of the total cropland was rented but only one-fourth of the permanent pasture was

TABLE 1

Means of Selected Measurements for Size and Efficiency Per Farm by Resource Area Groupings and Based Upon Major Land Resource Areas on Large Dairy Operations, West Virginia, 1970

Items Compared	Counties by Resource Areas				Average for All Areas
	Berkeley Grant Greenbrier Jefferson Mineral Monroe	Fayette Nicholas Preston Taylor	Jackson Mason Wood	Average ¹	
Herd Size, Cows	135	120	138	134	
Farm Size, Acres	810	759	797	793	
Pasture, Acres	309	266	314	311	
Cropland, Acres	360	273	285	324	
Man Equivalents ²	5.5	3.9	5.5	5.3	
Animal Units ²	214	171	380	252	
Productive					
Man-Work Units ²	1,967	1,486	1,926	1,872	
Animal Units Per					
Man Equivalent	39	43	68	48	
Milk Cows Per					
Man Equivalent	24	30	25	25	
P.M.W.U. Per					
Man Equivalent	355	378	345	355	
Cropland Per					
Man Equivalent	65	70	51	62	
Total Farm Acreage					
Per Milk Cow	6.0	6.3	5.7	6.0	
Cropland Per					
Milk Cow	2.6	2.3	2.1	2.4	
Amount of Loans Per					
Farm (Dollars)	50,800	68,333	54,571	54,968	
Total Assets Per					
Farm (Dollars)	299,700	198,571	284,050	275,014	
Assets Per Milk					
Cow (Dollars)	2,220	1,655	2,058	2,052	
Milk Production Per					
Cow (Pounds)	12,695	12,985	11,491	12,486	

¹ From left to right, the number of observations per resource area column were 22, 7, and 11, respectively.

² A man equivalent is one adult male worker between 18-60 years of age working 12 full months (250 days). An animal unit is a mature beef cow or horse or their equivalent based upon quantities of feed ingested by these animals. A productive man work unit (P.M.W.U.) is the amount of farm work done by a man in a 10-hour day.

TABLE 2

Acreage of All Rented and Owned Land and by Major Use on Large Dairy Operations, West Virginia, 1970

Land Use by Ownership Status	Farms	Total	Average ¹	Range	Portion of Total	Per Animal Units
	Number	Acres	Acres	Acres	Per Cent	Acres
Total Cropland Rented	35	4,179	119	40-725	13.18	0.51
Total Cropland Owned	40	8,783	220	55-423	27.70	1.08
Total Cropland	40	12,962	324	113-793	40.88	1.59
Cropland Pasture Rented	2	183	91	90-93	—	—
Cropland Pasture Owned	10	518	52	8-110	—	—
Total Cropland Pasture	12	701	58	8-110	2.21	0.08
Permanent Pasture Rented	15	2,968	198	20-655	—	—
Permanent Pasture Owned	40	9,455	236	33-600	—	—
Total Permanent Pasture	40	12,423	311	20-655	39.18	1.52
Brush and Timber Rented	10	405	40	5-125	—	—
Brush and Timber Owned	29	3,839	132	3-746	—	—
Total Brush and Timber	31	4,244	137	3-746	13.38	0.52
All Other Land Rented	13	399	10	5-190	—	—
All Other Land Owned	40	980	24	4-80	—	—
Total of All Other Land ²	40	1,379	34	4-190	4.35	0.18
Total	40	31,709	793	190-1675	100	3.89

¹The addition of these averages does not equal the total because of unequal farm numbers for all land usage.

²Percentage distribution of all other land: orchards (12%); farmstead, roads, and waste (61%); idle land (1%); and land in Soil Bank (26%).

rented. Most dairy operators (35 out of 40) rented additional cropland, ranging from 40 to 725 acres. The amount owned ranged from 55 to 423 acres, and the total amount of cropland ranged from 113 to 793 acres. Permanent pasture needs were not as critical as cropland, due to the practices of limiting pasture grazing of dairy cows. Hence, only 15 operators rented additional pastureland and the average total pastureland rented ranged from 20 to 655 acres. Most rented pastureland was rented in conjunction with whole farm rentals.

The remaining portion of the total land area reported contained approximately two per cent cropland pasture, 14 per cent brush and timber, and four per cent of all other land.

Considering the total land acreage and animal units, there was an average of 3.89 acres of land used per animal unit. Cropland and pastureland per animal unit were nearly equal. One and one-half acres of both cropland and pasture were used for one animal unit.

Land Classification

Soil maps of all the land, owned and rented, used by these operators were obtained from the Soil Conservation Service. A grid was used to measure the acreage on every farm unit. Therefore, a nearly exact measure of acreage is presented in Table 3.

Sixty-seven per cent of all the land area on these 40 operations was land classes I to IV. This compares to 23 per cent of the land area for the same land classes in the State. An analysis of the cropland of the operations revealed six per cent of the land was class I, 31 per cent was class II, 16 per cent was class III, and 14 per cent was class IV.

Twenty-nine operators rented additional land. These operators rented a total of approximately one-fourth of the total land used in all 40 operations. An average of 30 per cent of the cropland (classes I-IV) was rented.

CROP PRODUCTION

Most large operations in the State depend heavily on corn and hay as their major crops. Eighty-two per cent of the total cropland acreage was in corn grain, corn silage, and hayland (Table 4). A further analysis of these three crops shows an average of 94 acres of corn grain on 26 operations, 95 acres of corn silage on 40 operations, and 113 acres of hayland on 39 operations. The lone operator without hay acreage had recently moved his operation and had not seeded to hay. Fourteen of the 26 operators raising corn grain were located in Berkeley and Jefferson counties. The corn grain acreage on the operations in these counties amounted to 68 per cent of the corn grain acreage reported. These same 14 operators averaged 100 acres more cropland than did all 26 operators.

About one-half of the land used for corn grain and hay was rented but only

TABLE 3
Relative Distribution of Land on Large Dairy Operations by Land Classes,
West Virginia, 1970

Land Class	Rented		Owned		Total	
	Acreage	Per Cent	Acreage	Per Cent	Acreage	Per Cent
I	632	33	1,267	67	1,901	6
II	3,284	34	6,437	66	9,719	31
III	1,382	27	3,670	73	5,052	16
IV	1,093	24	3,465	76	4,558	14
Total I-IV	6,391	30	14,839	70	21,230	67
VI	1,295	21	4,983	79	6,278	20
VII	730	18	3,316	82	4,046	13
VIII	—	—	155	100	155	—
Total Acreage	8,416	26	23,293	74	31,709	100

TABLE 4
Total and Average Acreage of All Rented and Owned Land in Crops, by Crop Use, on
Large Dairy Operations, West Virginia, 1970

Ownership Status of Cropland	Farms	Total	Average ¹	Range	Portion		Per Animal Unit ²
					of Total Cropland	Per Cent Acres	
Total Cropland Rented	Number 35	Acres 4,179	Acres 119	Acres 40-725	32.23		
Total Cropland Owned	40	8,783	220	55-423	67.76		
Total Cropland	40	12,962	324	113-793	100.00		1.59
Corn Grain Rented	13	1,199	92	20-230	9.25		
Corn Grain Owned	21	1,235	59	14-167	9.53		
Total Corn Grain	26	2,434	94	14-230	18.78		0.43
Corn Silage Rented	13	640	49	15-255	4.94		
Corn Silage Owned	40	3,168	79	14-380	24.44		
Total Corn Silage	40	3,808	95	14-380	29.38		0.47
Sorghum Land Rented	3	130	43	20-80	1.00		
Sorghum Land Owned	4	126	31	6-70	1.00		
Total Sorghum Land	6	256	43	6-80	2.00		0.24
Oats Grain Rented	5	117	23	10-40	0.97		
Oats Grain Owned	8	276	34	5-106	2.13		
Total Oats Grain	11	393	36	5-106	3.10		0.16
Oats Silage Rented	1	100	100	100	0.77		
Oats Silage Owned	3	75	25	5-40	0.58		
Total Oats Silage	4	175	44	5-100	1.35		0.20

Wheat Grain Owned	5	200	20	12-100	1.37	
Total Wheat Grain	11	358	32	12-100	2.76	0.15
Wheat Silage Rented	4	128	32	8-80	0.99	
Wheat Silage Owned	4	52	13	14-28	0.40	
Total Wheat Silage	5	180	36	8-80	1.39	0.18
Barley Grain Rented	4	357	89	30-142	2.75	
Barley Grain Owned	11	365	33	20-80	2.81	
Total Barley Grain	13	722	55	20-142	5.56	0.27
Barley Silage Rented	3	23	8	8-10	0.18	
Barley Silage Owned	3	95	32	25-45	0.73	
Total Barley Silage	4	108	27	8-45	0.91	0.15
Rye Grain Rented	—	—	—	—	—	
Rye Grain Owned	1	30	30	30	0.23	
Total Rye Grain	1	30	30	30	0.23	0.15
Rye Silage Rented	2	75	37	15-60	0.58	
Rye Silage Owned	—	—	—	—	—	
Total Rye Silage	2	75	37	15-60	0.58	0.12
Soybeans Rented	1	21	21	21	0.16	
Soybeans Owned	—	—	—	—	—	
Total Soybeans	1	21	21	21	0.16	0.12
Hayland Rented	18	1,378	76	10-355	10.62	
Hayland Owned	37	3,024	82	10-250	23.33	
Total Hayland	39	4,401	113	10-355	33.95	0.55

¹The addition of these averages does not equal the total because of unequal farm numbers for all land usage.

²The acres per animal unit shown in the subtotal of the cropland does not equal 1.59 which was the acres of total cropland used per animal unit on all farms. This happened because the acres per animal unit were figured in this calculation using only the total animal units on the farms growing each crop.

17 per cent of the corn silage land was rented. Corn silage seems to be the one crop most operators rely upon heavily because they raise most of the crop on owned land.

The remaining crop acreage totaled only 18 per cent of the cropland. This 18 per cent included five per cent oats, four per cent wheat, six per cent barley, and three per cent sorghums, rye, and soybeans used as grain and silage. The 13 different operators that raised small grains averaged 36 acres of oats, 32 acres of wheat, and 39 acres of barley. Sorghums, rye, and soybeans were almost non-existent. The operators in Jefferson and Berkeley counties grew 41 per cent of the oats, 54 per cent of the wheat, and 91 per cent of the barley grown on the 40 large dairy operations.

Of the 1.59 acres of the total cropland used to maintain one animal unit, corn and hay accounted for 1.45 acres. More detailed analysis showed 0.43 acre of corn grain, 0.47 acre of corn silage, and 0.55 acre of hay. The remaining crops, oats, wheat, and barley for grain, were grown on 0.16, 0.15, and 0.27 acres, respectively.⁷

Fertilization

The amount of fertilizer used on land affects yields, costs, and returns. Different soils require different levels of fertilization, therefore, making it more costly for some dairy operators to raise certain crops than others. Table 5 gives the number of operators using selected levels of fertilization for different crops.

All the operators reported growing corn for silage, but one operator did not indicate whether or not he used fertilizer (Table 5). More than one-third of those operators reporting fertilizer rates used 101 to 150 pounds of nitrogen per acre—the largest number of operators using the heaviest application rate for any of the crops reported. The fertilizer application rates of phosphorus and potassium were also heavy (51 to 100 pounds) for corn silage, and again more operators used these elements at heavy application rates than for any other crop reported. One operator reported using over 200 pounds per acre of phosphorus and potassium on corn silage, which was the heaviest application rate of plant nutrients used on any crop reported.

Nearly all operators also reported having fertilized permanent pasture, but more than half of those fertilizing pastures used no nitrogen and few used more than 50 pounds per acre. The low use of commercial nitrogen fertilizers on pasture was probably due to heavy applications of manure. Almost two-thirds of the operators fertilizing used phosphorous on pastures and 29 per cent of those

⁷The acres per animal unit contained in the subtotals of the cropland does not equal 1.59 which was the acres of total cropland used per animal unit. This happened because the acres per animal unit were figured with only the total animal units on the farms raising each crop.

using phosphorus applied it at a rate between 51 to 100 pounds per acre. Twenty-six per cent of those applying potassium used it at a rate less than 51 pounds per acre, but almost an equal percentage applied potassium at between 51 to 100 pounds per acre.

Haylands also ranked high among the crops that were fertilized. Nearly half of those operators fertilizing hay used nitrogen at less than 51 pounds per acre. The low rate of commercial nitrogen used also probably stems from the application of manure. Larger percentages of operators used phosphorus and potassium on haylands than used these nutrients on pasture at rates of 1 to 50 pounds and 51 to 100 pounds per acre.

More than half of the operators reported fertilizing corn grain. The percentages of operators applying each of the plant nutrients for each of the selected rates compared favorably with the same selected rates of corn silage, but only about two-thirds (25 versus 39) as many fertilized corn grain as fertilized corn silage.

Almost equal numbers of operators grew and fertilized the small grain crops of oats, wheat, and barley. Nitrogen was the plant nutrient reported used by the largest percentage for each of the small grains, and nearly all operators applied it at a rate of less than 51 pounds per acre. The percentage of operators using phosphorus and potassium ranged from 53 to 73 per cent of those fertilizing and at a rate of 50 pounds or less per acre.

A statistical test involving the relationship between various crops grown, fertilizer rates used, and the effect upon yields indicated that the yields of corn silage were responsive to increased rates of fertilizer applications.⁸ Also with corn silage there was a significant increase in yields to the single individual fertilizer element, nitrogen.⁹ Examination of the data for other crops and other fertilizer elements at the rates tested did not prove to be significant.

Yields

The yields of crops grown varied due to the wide range of management practices, soils, elevations, and local climates encompassed in this study. Yields on every crop ranked in the upper 40 per cent of yields on all commercial farms in West Virginia. The yields presented in Table 6 are those reported by the interviewed dairy operators. Not all operators raising crops reported crop yields.

Twenty-one operators averaged 99 bushels of corn per acre with yields ranging from 70 to 150 bushels per acre. An average of 21.5 tons of corn silage per acre was harvested by 35 dairy operators. The tonnage of corn silage produced ranged from 12 to 30 tons per acre. Acreages of oats, barley, and

⁸Rejection of the null hypothesis $R = 0$ at the 5% level, $r = .502$ with 35 d.f.

⁹Rejection that $P = 0$ at the 5% level, $r = .591$ with 34 d.f.

TABLE 5
Commercial Fertilizer Nutrients Reported by Selected Rates of Application
Per Acre on Crops and Pasture by Large Dairy Operators, West Virginia, 1970

Type Crop and Plant Nutrients	Growing Crop	No. of Operators Reporting ¹	Fertilizing Rates	Per Cent of Operators Reporting Using Various Plant Nutrients by Selected Application Rates in Pounds Per Acre						
				1- 50	51- 100	101- 150	151- 200	Over 200		
Corn Silage	40	—	39	—	—	—	—	—		
Nitrogen	—	0	—	23	20	38	19	0		
Phosphorus	—	0	—	18	36	28	15	3		
Potassium	—	0	—	23	34	20	20	3		
Permanent Pasture	40	—	38	—	—	—	—	—		
Nitrogen	—	53	—	42	5	0	0	0		
Phosphorus	—	34	—	26	29	8	3	0		
Potassium	—	47	—	26	24	0	3	0		
Hayland	39	—	37	—	—	—	—	—		
Nitrogen	—	38	—	49	13	0	0	0		
Phosphorus	—	14	—	30	48	0	8	0		
Potassium	—	16	—	35	30	5	14	0		

TABLE 6
Reported Yields Obtained on Selected Crops on
Large Dairy Operations, West Virginia, 1970

Crop	Unit	Farms Reporting Crop	Average Yield	Range of Yield
		Number	Number	Number
Corn Silage	Ton	35	21	12-30
Corn	Bu.	21	99	70-150
Oats	Bu.	7	56	50-70
Barley	Bu.	9	72	52-100
Wheat Silage	Ton	1	7	7
Wheat	Bu.	7	38	35-45
Hay ¹	Ton	27	4	1.5-7.0

¹Includes all hay, both chopped and baled. Yields on baled hay only were 3.9 tons per acre. Chopped hay yields were 5.5 tons per acre, and a combination of chopping or baling yielded 4.3 tons per acre.

One ton of baled hay with 12 per cent moisture is equivalent to 1.75 tons of chopped hay with 50 per cent moisture used for haylage. On a dry matter basis one ton of hay equals .87 ton of haylage. Information obtained from John A. Speicher and L. H. Brown, "Budgeting Feed for Bigger and Better Herds," *Hoard's Dairyman*, Vol. CXV, No. 15 (August 10, 1970), p. 817.

wheat were also harvested as silage. However, only one operator reported a seven-ton yield per acre of wheat silage. Seven operators reported yields of oats and wheat grain. Oats production ranged from 50 to 70 bushels per acre with an average of 56 bushels. Those operators raising wheat averaged 38 bushels per acre. Wheat yields ranged from 35 to 45 bushels per acre. Barley yields were reported by nine operators. The range of barley yields was 52 to 100 bushels per acre with nine dairy operators averaging 72 bushels of barley per acre.

Twenty-seven operations averaged 4.3 tons of hay per acre. These yields included crops that were baled, chopped, or partially baled and partially chopped. Those operators who only baled hay averaged a yield of 3.9 tons per acre and those who chopped their hay averaged 5.5 tons per acre. Yields of 4.3 tons per acre were obtained by operators who both baled and chopped their hay crop.

Manure Use

Manure disposal from dairy herds, which may cause environmental pollution, is not a serious problem in West Virginia at present since there is no

great concentration of dairy herds. However, this problem does exist in some areas outside of West Virginia. Careful management of manure is essential to avoid possible problems in the future. The spreading interval and utilization of manure applications by classes of land are presented in Table 7.

Eighty-five per cent of the operators spread manure one or more times a week in the summer. Twenty-eight per cent of the operators spread manure daily in the summer, excluding Sunday. Nineteen per cent spread manure on cropland daily. A spreading interval of every two days was followed by 25 per cent of the

TABLE 7

Manure Application by Land Use, Season and Spreading Interval on Large Dairy Operations, West Virginia, 1970

Season and Spreading Interval	Land Use			All Uses
	Cropland	Intended Corn Land	Pasture	
	Per Cent			
Summer				
Daily	19	2	7	28
Every Two Days	7	9	9	25
Twice a Week	7	9	2	18
Once a Week	7	5	2	14
Three Times a Month	—	2	—	2
Twice a Month	2	5	2	9
Four Times a Season	—	2	—	2
Six Times a Season	2	—	—	2
Once a Year	—	—	—	—
Summer, All Land Uses	44	34	22	100
Winter				
Daily	23	14	14	51
Every Two Days	4	9	4	17
Twice a Week	4	4	—	8
Once a Week	2	6	—	8
Three Times a Month	—	2	—	2
Twice a Month	—	2	—	2
Four Times a Season	—	2	—	2
Six Times a Season	—	2	—	2
Once a Year	4	4	—	8
Winter, All Land Use	37	45	18	100

operators. Cropland, other than that in corn, was used for spreading by seven per cent, cornland was used by nine per cent, and pasture was used by nine per cent of the operators spreading at two-day intervals. Crop rotations make summer manure application possible. Eighteen per cent of the operators spread twice a week. Of these operators, seven per cent spread on cropland, nine per cent spread on cornland, and two per cent spread manure on pastureland. Once-a-week spreading was followed by 14 per cent of the operators. Seven per cent of the operators used cropland for spreading, five per cent used cornland, and two per cent of the operators spread on pastureland. The remaining 15 per cent used spreading intervals of three times a month, two times a month, and six times a year. Summer manure application by land use shows 44 per cent of the operators using cropland, 34 per cent using land intended for corn, and 22 per cent using pastureland.

Daily spreading occurred more frequently in winter than in summer. A total of 51 per cent of the operators spread manure daily in the winter, 23 per cent of them on cropland, 14 per cent on cornland, and 14 per cent on pastureland. Seventeen per cent of the operators followed an every-other-day spreading schedule. Four per cent of them spread on cropland and four per cent on pastureland. The remaining nine per cent spread on cornland. The twice-a-week and once-a-week intervals were both used by eight per cent of the operators. The remaining 16 per cent of the total using various spreading intervals applied manure mostly to cornland. The total of winter manure applications by land use shows that 37 per cent of the operators used cropland, 45 per cent used cornland, and 18 per cent used pasture.

Selected Practices

Corn was both sprayed and cultivated for weed control by 40 per cent of the dairy operators (Table 8). Five per cent only cultivated their corn and 55 per cent only sprayed their corn. Sod planting of corn is coming into increasing use in West Virginia. Ten per cent of the operators sod planted all their cornland, while 30 per cent used a combination of both sod planting and the traditional style of planting corn. The remaining 60 per cent planted corn in the traditional manner only.

Hay was harvested by all operators with the aid of either mower conditioners or hay conditioners. Forty per cent used mower conditioners, 67.5 per cent used hay conditioners, and three operators (7.5 per cent) used both mower conditioners and hay conditioners. A majority of the operators (60 per cent) baled all of their hay crop while 32.5 per cent combined baling with chopping. Several of the operators indicated they wanted to completely abandon the baling of hay. Time and labor were the major reasons. Only five per cent of the operators were chopping all of their hay. One operator, previously mentioned, reported raising no hay.

TABLE 8
Selected Practices¹ Used on Large Dairy Operations,
West Virginia, 1970

Practices Pertaining to Crops	Farms Using Practice
	Per Cent
Corn Planting	
Sprayed	55.0
Cultivated	5.0
Sprayed and Cultivated	40.0
Sod Planted	10.0
Conventional Planted	60.0
Sod and Conventional Planted	30.0
Hay Harvest	
None	2.5
Chopped	5.0
Baled	60.0
Chopped and Baled	32.5
Mower Conditioner	40.0
Conditioner	67.5
Liquid Nitrogen	
None	40.0
Cornland	45.0
Pasture	5.0
Cornland and Pasture	10.0

¹For liming practices, see text.

Usage of liquid nitrogen brought about the widest range of opinions pertaining to cropping practices. Many operators quit applying liquid nitrogen to early pasture because they felt the costs exceeded the small amount of additional early pasture which was obtained. Forty per cent of the operators applied no liquid nitrogen to either cornland or pasture. Forty-five per cent applied some to cornland, five per cent used liquid nitrogen on early pasture, and 10 per cent used it on both cornland and pasture.

Those operators following liming practices did so on the average of once every three years. Thirty-one operators limed an average of 121 acres of cropland at the rate of 2.16 tons per acre (Table 9). An average of 96 acres of pastureland was limed at the rate of 2.05 tons per acre on 22 operations.

TABLE 9
Liming Practices for 1967-1969 Reported by
Large Dairy Operations, 1970

Type of Land Limed	No. of Farms Applying Lime	Average Acreage Limed Per Farm	Average Rate of Application
			Per Acre Tons
Crop	31	121	2.16
Pasture	22	96	2.05

ANIMAL RESOURCES

An accurate account of all dairy operations, dairy cow numbers, and average milk production in West Virginia is difficult to obtain. There are indications that the commercial dairy operations in the State are becoming larger. Three out of the last four Agricultural Censuses showed an increase of dairy cow numbers in State commercial dairy operations with sales of \$10,000 or more. The number of cows in these operations increased from 20,941 cows in 1954 to 27,768 in 1964 (Table 10). However, in 1969 the estimated number dropped by 1,469 to a total of 26,299 cows. The average yearly milk production per cow increased by approximately 1,400 pounds during each of the past four Agricultural Census periods. The annual milk production in 1954 was 5,697 pounds per cow and had increased to 7,201 pounds, 8,606 pounds, and 9,956 pounds in the census years of 1959, 1964, and 1969, respectively.

Comparison of commercial dairy operations of the State to the Dairy Herd Improvement Association (DHIA) herds shows that milk production was 2,000 pounds greater per cow for DHIA members than for all commercial dairy operators during each of the past four Agricultural Census periods. The extra 2,000 pounds of milk produced annually per cow is very attractive to the dairymen. This might explain the increase in DHIA members and cow numbers. From 1954 to 1969, DHIA cow numbers increased from 7,215 cows to 10,926 cows, a 51 per cent increase.

Herd Size

The 40 herds included in this study averaged 134 milking cows (Table 11). The range included the minimum of 100 cows and rose to a high of 352 cows. An average of 20 per cent of the cows in a herd were dry for each two-month dry period. Thus, the average number of cows milked on these operations totaled 107. The cows milked ranged from 70 to 240. The operations averaged

54 heifers over one year of age and 41 heifers under one year of age. On these operations, the number of heifers over one year of age ranged from 19 to 175 and from 14 to 125 for heifers under one year of age.

Twenty-nine operations had herd bulls and 21 were raising young bulls. Each operation averaged two herd bulls and 1.7 young bulls. Some operators had up to eight herd bulls. Seventy-two per cent of the operations used purebred herd bulls. Only four operations raised any livestock other than dairy cattle. The other animals were beef, hogs, and sheep and averaged 139 animals per operation for those operations having animals other than dairy cows. Taking into consideration a conversion to animal units, these non-dairy animals averaged 60 animal units per operation on the four operations.

A conversion to animal units from actual animal numbers adjusts every animal to a common standard for means of comparison. The average milk herd

TABLE 10
Number of Dairy Cows and Average Yearly Milk
Production for DHIA and Commercial Dairy
Operations, West Virginia, 1954-1969

Year	DHIA		Commercial Dairy Operations ¹	
	Cows	Production	Cows	Production
	Number	Pounds	Number	Pounds
1954	7,215	8,150	20,941	5,697
1959	8,336	9,016	26,497	7,201
1964	8,620	10,627	27,768	8,606
1969	10,926	12,019	26,299 ²	9,956 ²

Sources: Cow numbers and production records for DHIA members were obtained from the office of R. O. Kelley, State Extension Specialist-Dairy, Division of Animal and Veterinary Sciences, West Virginia University.

U.S. Bureau of the Census, *U. S. Census of Agriculture*: 1954: Vol. 1, Part 15, p. 446; 1959, Vol. 1, Part 25, pp. 116-117 (Washington: U. S. Government Printing Office, 1956, 1961, 1967).

¹Commercial farms as defined in the Census include all farms with a value of sales amounting to \$2,500 or more. Farms with a value of sales of \$50 to \$2,499 were included as commercial farms if the operator was under 65 years of age and did not work off the farm 100 or more days during the year. However, this table includes all commercial dairy farms (DHIA and Non-DHIA) with a value sales of \$10,000 or more.

²Estimates for 1969 were obtained from the use of a second degree equation, $Y = a + bx + cx^2$. See Herbert Arkin and Raymond R. Colton, *Statistical Methods*, 4th ed.; (New York: Barnes and Noble, Inc., 1955), pp. 62-66.

TABLE 11
Total and Average Number of Animals and Animal Units on Large Dairy Operations, West Virginia, 1970

Types of Animals	Farms Reporting	Total	Animals Per Farm	Range	Animal Units ¹	
					Total	Per Farm
Herd Total	40	5,347	134	100-352	5,882	147
Cows Milked	40	4,295	107	70-240	4,724	118
Heifers Over 1 Year	40	2,180	54	19-175	1,177	29
Heifers Under 1 Year	40	1,649	41	14-125	561	14
Herd Bulls	29	61	2	1-8	67	2.3
Young Bulls	21	35	1.7	1-7	12	0.6
Other Animals ²	4	558	139	20-365	240	60

¹A dairy cow equals 1.1 animal units, and a beef cow equals only 1.0 animal unit. Other animal units are derived upon the equivalent to a beef cow based upon feed intake.

²Other animals include beef, hogs, and sheep.

of 134 cows had 147 animal units. Heifers over and under one year of age averaged 29 and 14 animal units per operation, respectively.

Milk Production

The average annual milk production reported for the 40 herds was 12,486 pounds per cow. The herds' production average reported ranged from a low of 10,000 pounds to a high of 16,200 pounds per cow annually (Table 12).

The Ohio Valley operations reported the lowest average annual production, 10,905 pounds. Production averages of 12,653 pounds and 13,703 pounds were obtained by the operators in the Jefferson-Berkeley County area and the Greenbrier Valley area, respectively.

The butterfat test simple average was 3.8 per cent for all 40 herds. The test range was from 3.4 per cent to 4.3 per cent. The 3.8 per cent butterfat test reported was considered relatively high inasmuch as 90 per cent of the herds were Holsteins.

Fifteen operators did not belong to any record keeping organization such as Dairy Herd Improvement Association or Weigh-a-Day-a-Month (WADAM). Of the remaining operators, 22 belonged to the DHIA or DHIR (Dairy Herd Improvement Registry), one operator was on the WADAM program, and two operators were on both the DHIA and electronic farm accounting program.

Herd Breeding and Replacement

Operators of eight of the 40 herds used no artificial insemination, whereas 23 operators serviced all of their cows by artificial insemination. However, many

TABLE 12

**Annual Milk Production Per Cow on Large Dairy Operations
by Class Intervals and Number of Herds Producing at Each
Level, West Virginia, 1970**

Range of Per Cow Production ¹	Herds
Pounds	Number
10,000 to 10,999	7
11,000 to 11,999	8
12,000 to 12,999	10
13,000 to 13,999	5
14,000 to 14,999	9
15,000 or more	1

¹ Milk production levels were not fat corrected.

of these same operators kept bulls to breed hard breeders. The remaining nine operators used artificial insemination on 25-80 per cent of the cows in their herds. Herd bulls were used mostly for breeding first-calf heifers. Fifty per cent of the operators used herd bulls on first-calf heifers and 30 per cent of the operators used beef bulls for these heifers. Only 12.5 per cent of the operators used artificial insemination on first-calf heifers. The remaining operators used combinations of the three methods for breeding heifers.

There were only five purebred herds. Nineteen herds were at least 90 per cent grade and 13 of these herds contained all grade cows. The other 16 herds had grade cows making up 25-80 per cent of the herds. Twenty-one of 40 operators indicated they would not increase the number of purebred dairy cows in their herd. Several operators indicated that the purebred cow did not pay for herself in their operations. Holsteins were the most common breed of cattle, accounting for 36 of the 40 herds. The remaining four herds were made up of mixed breeds.

Proper culling and replacement practices are crucial to a dairyman. The average reported age of a cow in this study was 5.3 years. However, a Holstein cow does not obtain her mature equivalent until the age of between 6 to 8.5 years.¹⁰ The annual average cull rate was 18 per cent. Assuming that every cow calves during the year, the average calf loss was 6.7 per cent per herd per year.

Thirty-one operators kept all heifer calves for replacement purposes, and an additional six operators kept 90 per cent or more of their heifer calves. High market prices in recent years have influenced several operators to raise dairy steers. Thirty per cent of the operators raised dairy steers, 42.5 per cent sold bull calves at local stock sales, and 25 per cent of the operators sold bull calves to local people.

Only 12 out of 40 operators bought additional herd replacements, and then most of them bought a relatively small percentage of replacements. Eight operators bought heifer replacements. Fifty per cent of these operators bought from local dairies, 25 per cent bought from out-of-state sales, and 25 per cent bought from state and/or disposal sales. Eight operators bought cow replacements. Fifty per cent of these operators bought from disposal sales and 25 per cent bought from both state sales and local dairies.

Operators gave many reasons for raising their own replacements. The major reasons dealt with either economics, genetics, or a combination of the two. Thirty-eight per cent of the operators believed that it was cheaper to raise

¹⁰J. F. Kendrick, *Standardizing Dairy Herd Improvement Association Records in Proving Sires*, U. S. Department of Agriculture, Dairy Husbandry Research Branch ARS-52-1 (Washington: U. S. Printing Office, January, 1955), pp. 2 and 8. To correct production records for variation caused by differences in age, production records are converted to a mature-equivalent basis.

replacements. An average heifer replacement cost of \$430 was given by these operators. The cost figures given ranged from \$260-\$600. Thirty-eight per cent of the operators believed they could raise better quality replacements by knowing the genetic history of their cows and the type of bulls used for breeding. A few operators said they raised replacements because they could not find suitable quality or they had trouble fitting replacements into their operation.

Nearly one-half of the operators claimed they would not purchase replacements of satisfactory quality even if they found them. The quantity of labor used on these operations did not seem to be affected by the operators raising their own replacement heifers. Only nine operators said that their labor force could be reduced if they bought their herd replacements.

Feeding Practices

The feeding practices followed by these operators were divided into three time periods. They were:

1. spring-early summer
2. late summer-fall
3. winter

The summer season was divided because the non-dry lot herd's dependency on pasture ends sometime during the summer. Therefore, a change in feeding practices is necessary after cows were removed from pasture.

SPRING-EARLY SUMMER. The operators reported feeding milk cows an average of 15 pounds of concentrates per day with a range of 8 to 30 pounds (Table 13). Dry cows were fed an average of 7.5 pounds, and heifers were fed an average of five pounds of concentrates a day. However, there were 10 operations that fed no concentrates to dry cows in the spring-early summer. Nineteen operations reported feeding no concentrates to heifers, and one operator reported free choice concentrates to his heifers.

Milking cows and heifers were fed an average of eight pounds of hay per day per cow while dry cows were fed 10 pounds of hay per day. Hay was fed by free choice to milking cows on two operations, while one operator fed dry cows and another operator fed heifers hay by free choice. Milking cows in 16 operations, dry cows in 32 operations, and heifers in 38 operations were fed no hay in the spring-early summer period.

Silage was fed to milking cows at an average rate of 42 pounds per day, ranging from 10 to 90 pounds. Eight operators fed no silage to milking cows and four fed by free choice. Dry cows were fed 40 pounds of silage a day and heifers were fed 30 pounds. Twenty-one operators fed no silage to dry cows and 34 operators fed none to heifers.

Green chop was fed to milking cows at an average rate of 76 pounds per day by 10 operators. The amount of green chop fed ranged from 33 to 117 pounds.

TABLE 13

Reported Feeding Practices for Milking Cows, Dry Cows, and Heifers During
Spring-Early Summer on Large Dairy Operations, West Virginia, 1970¹

Feed and Animals Fed	Farms Not Feeding	Farms Reporting ²	Feeding Free Choice	Spring-Early Summer Feed ³	Range
	Number	Number	Number	Lb./Day/Animal	Lb./Day/Animal
Concentrates					
Milking Cows	—	39	—	15.0	8-30
Dry Cows	10	30	—	7.5	2-20
Heifers	19	20	1	5.0	2-10
Hay					
Milking Cows	16	22	2	8.4	2-15
Dry Cows	32	7	1	10.0	5-15
Heifers	38	1	1	8.0	8
Silage					
Milking Cows	8	28	4	42.0	10-90
Dry Cows	21	14	5	40.0	10-90
Heifers	34	1	5	30.0	30
Green Chop					
Milking Cows	30	10	—	76.0	33-117
Dry Cows	34	6	—	—	—
Heifers	38	2	—	—	—

¹The spring-early summer season included the months of April, May, June, July.

²Due to an inconsistency in the data for concentrates fed milking cows, data for one operator were eliminated.

³Amount of feed fed is calculated on an individual herd average basis.

LATE SUMMER-FALL. Concentrates fed to milking cows increased an average of two pounds a day over the spring and early summer feeding season while the amount fed to dry cows remained nearly constant (Table 14). There was a slight drop in the amount of concentrates fed to heifers. The late summer-fall season feeding practices resulted in an additional six operators feeding dry cows concentrates and an additional 12 operators feeding heifers concentrates.

The amount of hay fed to milking and dry cows increased by 1.7 pounds per day as compared to the spring and early summer quantities. Heifers were fed an additional six pounds of hay per day. The amount of hay fed to these three groups of cattle ranged from three pounds to 35 pounds. Five operators did not feed hay to milking cows, seven did not feed hay to dry cows, and 10 operators did not feed hay to heifers.

Only one operator did not feed silage to milking cows in the late summer-fall. The average amount of silage fed to milking cows rose from 42 to 48 pounds per day while the amount of silage fed to dry cows fell two pounds to 38 pounds a day and heifers were fed 23 pounds per day, nine pounds less than during the spring-summer season. There was an increase of five in the number of operations feeding silage by free choice as compared to the spring season.

A total of 14 operators fed an average of 71 pounds of green chop per day to milking cows during two months of fall. As in the spring season dry cows and heifers were not fed green chop.

WINTER. During the winter season, each milking cow was fed an average of 18 pounds of concentrates per day, ranging from a low of eight pounds to a high of 35 pounds (Table 15). The amount of concentrates fed to dry cows and heifers remained fairly constant at 7.7 pounds and 5.1 pounds per day. Three operators did not feed hay to milking cows or heifers and five operators fed no hay to dry cows. The amount of hay fed per day averaged 12.3 pounds per milking cow, 13.6 pounds per dry cow, and 15 pounds per day per heifer. The amount of hay fed ranged from two pounds to 33 pounds per day. Five of 40 operators fed silage by free choice to milking cows, with the remaining 35 operators feeding an average of 53 pounds of silage, ranging from 25 pounds to 92 pounds per cow. Forty-two pounds of silage were fed per dry cow and 25 pounds were fed per heifer. There were a few operations that fed no silage in the winter to dry cows or heifers.

A summary of the feeding practices followed shows the amount of concentrates fed to dry cows and heifers remained fairly constant throughout the year. Concentrates fed to the milking cows varied from 8-35 pounds per day per cow depending on the season of the year. Operators acquired the concentrates fed on these operations by either raising the grain, buying the grain, or buying a dairy ration. Eight operators raised all the grain needed for concentrate feeding and 14 operators raised at least 50 per cent of the needed

TABLE 14

Reported Feeding Practices for Milking Cows, Dry Cows, and Heifers During Late Summer-Fall on Large Dairy Operations, West Virginia, 1970¹

Feed and Animals Fed	Farms Not Feeding		Farms Reporting ²		Feeding Free Choice		Late Summer-Fall ³		Range
	Number		Number		Number		Lb./Day/Animal		
Concentrates									
Milking Cows	—		39		—		17.0		8-35
Dry Cows	4		36		—		7.7		2-20
Heifers	7		32		1		4.8		2-10
Hay									
Milking Cows	5		32		3		10.1		3-23
Dry Cows	7		31		2		11.7		3-35
Heifers	10		26		4		14.0		3-32
Silage									
Milking Cows	1		34		5		48.0		15-90
Dry Cows	7		27		6		38.0		15-90
Heifers	12		20		8		23.0		5-40
Green Chop									
Milking Cows	26		14		—		71.0		33-117
Dry Cows	33		7		—		—		—
Heifers	37		3		—		—		—

¹The late summer-fall season included the months of August, September, October, and November.

²Due to an inconsistency in the data for concentrates fed milking cows, data for one operator were eliminated.

TABLE 15

Reported Feeding Practices for Milking Cows, Dry Cows, and Heifers During Winter
on Large Dairy Operations, West Virginia, 1970¹

Feed and Animals Fed	Farms Not Feeding		Farms Reporting ²		Feeding Free Choice		Winter Feed ³		Range
	Number		Number		Number		Lb./Day/Animal		Lb./Day/Animal
Concentrates									
Milking Cows	—		39		—		18.0		8-35
Dry Cows	4		36		—		7.7		2-20
Heifers	6		33		1		5.1		2-10
Hay									
Milking Cows	3		36		1		12.3		3-25
Dry Cows	5		33		2		13.6		3-30
Heifers	3		32		5		15.0		2-33
Silage									
Milking Cows	—		35		5		53.0		25-92
Dry Cows	3		31		6		42.0		11-95
Heifers	9		23		8		25.0		10-50

¹The winter season included the months of December, January, February, and March.

²Due to an inconsistency in the data for concentrates fed milking cows, data for one operator were eliminated.

³Amount of feed fed is calculated on an individual herd average basis.

grain. Two operators bought all of the grain used in their concentrates. A total of 27 operators mixed their own concentrates and 13 bought a dairy ration.

A further summary of the three seasonal feeding tables shows that the amount of hay fed to milking cows, dry cows, and heifers increased from spring-early summer to winter. The greatest increase in amount fed to milking cows and dry cows occurred between late summer-fall and winter. However, the greatest increase for heifers occurred between spring-early summer and late summer-fall.

Silage amounts fed to milking cows increased in the same manner as hay, but the amount of silage fed to dry cows peaked in the winter and reached its low in late summer-fall. The amount of silage fed to heifers peaked in the spring-early summer, dropped in late summer-fall, but increased again in the winter.

PASTURE AND SUPPLEMENTARY FEED. Eighty per cent of the operators reported their pasture season began between mid-April and the first of May. However, during the summer months pastures tend to lose some of their feeding value, so dairy operators do not depend entirely on pastures to maintain a dairy cow for a very long period of time. Thirty-five operations reported an average of 76 pasture dependent days. Five operators had completely dry lot operations. Supplementary summer feeding of roughage was needed on most operations and began as early as the first of June and as late as the middle of September, but with the majority starting to feed between the first of July and the first of August. However, a total of 29 operators fed roughage 12 months out of the year. Four operators used supplementary Sudangrass pasture an average of 54 days.

BUILDINGS AND EQUIPMENT

There are three major items to be discussed under the heading of buildings and equipment. These include the milking facilities, livestock housing, and power and equipment.

Milking Facilities

Stanchions and parlors, both herringbone and non-herringbone, were used by these operators. Nine of the 40 operators milked using the stanchion system with an average of 30 stanchions per operation (Table 16). These operators averaged a milking crew of 2.2 men and 2.1 milking units per man, with an average of 192 cows milked per farm per day. The number of cows milked per man-hour equalled 19.7 cows. This figure was lower than that represented by the herringbone parlors, but higher than the non-herringbone parlor systems.

Of the 27 operations using the herringbone parlor, four used the double-three, seven used the double-four, only one operator used the double-

Average Milking Crew, Milking Units Used, Cows Milked, and Total Farms Reporting by
Types of Milking System on Large Dairy Operations, West Virginia, 1970

Type of System	Farms Reporting	Average Size of Milking Crew ¹	Average Milking Units Per Man	Average	
				Cows Milked Per Farm Per Day ²	Cows Milked Per Man-Hour ⁴
Stanchion ³	9	2.2	2.1	192	19.7
Parlor—Herringbone					
Double—3	4	2.0	2.6	260	23.4
Double—4	7	1.7	3.0	183	23.1
Double—5	1	2.0	3.0	400	30.7
Double—6	11	2.0	2.9	199	27.0
Double—8	4	2.5	3.2	285	27.5
Parlor—Non-Herringbone					
Three In-line	1	2.0	1.5	140	14.7
Four In-line	2	2.0	2.0	208	14.3
Six In-line	1	3.0	2.0	260	14.4
All Farms	40	2.0	2.6	215	23.2

¹Milking crew included workers that not only milked, but workers that performed related jobs such as washing udders, letting cows in the parlor, etc.

²All herds were milked twice a day.

³Those operators using a stanchion system averaged 30 stanchions per operation.

⁴Includes all members of the milking crew (See footnote 1).

five, 11 operators had double-six parlors, and the remaining four operators used the double-eight herringbone parlor. The average milking crew ranged from 1.7-3.0 men. Operators using the double-three parlor and the double-six parlor both used two men for milking, even though the operators using the double-six milked an average of 199 cows per day compared to an average of 260 cows milked per day with the double-three systems. The double-six parlor system averaged 27 cows milked per man-hour, while the operators of the double-three averaged only 23.4 cows milked per man-hour. The operators with the double-three system averaged 2.6 milking units per man and the double-six system had a slightly higher average of 2.9 milking units per man. Interestingly enough, the only operator who used a double-five herringbone also milked the largest number of cows, 400 per day, and averaged the greatest number of cows, 30.7, milked per man-hour. This operator used two men for milking with an average of three milking units per man. Included in this double-five parlor system was a double-two preparation stall system. The double-four parlors had three milking units per man and the double-eight had 3.2, but the double-eight operators had an average of 2.5 men milking as compared to 1.7 men for the double-four systems. The average number of cows milked per man-hour by the double-four operators was 23.1 and the average number of cows milked per day was 183. The double-eight system averaged 27.5 cows milked per man-hour and 285 cows milked per day.

The four non-herringbone parlors were the least efficient in terms of cows milked per man-hour of all the milking systems studied. These parlors had three, four, and six milking stalls in a straight line. A two-man milking crew was used in all systems except the six in-line parlor. The additional walking distance required for this system apparently caused a third worker to be added to the milking crew. The operator using this system indicated the need to switch to some type of herringbone parlor. One hundred forty cows per day were milked in the three in-line parlor system. The four in-line parlor averaged 208 cows milked per day and the six in-line averaged milking 260 cows per day. An average of approximately 14 cows per man-hour were milked in the non-herringbone milking parlors. Guidelines for efficient operations recommend larger parlors as herd size increases.¹¹ These guidelines are only approximate, however, since each dairy operation is managed differently.

¹¹C. R. Hoglund, "What is Your Best Buy in a Milking Parlor?" *Hoard's Dairyman*, Vol. CXV, No. 5 (June 25, 1970), pp. 693 and 705.

Bulk Tanks

All 40 operations had bulk milk storage tanks with some operators having two relatively small tanks instead of one large tank. One operation did not have a pipeline system and, therefore, the milk had to be carried from the stanchion barn to the bulk tank. The tank size used depended upon the number of cows milked and the frequency of milk pick-up.

The most common total milk storage capacity per farm was 1,000–1,020 gallons (Table 17). Five operations with both daily and every other day pickup schedules had bulk tanks with approximately 1,000 gallons storage capacity. The second most common range of storage capacity per operation for daily pickup schedule was 500–550 gallons to 600–680 gallons. The second most common ranges of capacity per operation for the every other day pick-up were 800-815 gallons and 1,150-1,200 gallons. The range of total milk storage capacity for operations with a daily pick-up schedule was 400 to 2,200 gallons, while the range for total milk storage capacity for every other day pick-up was 650 to 2,500 gallons. The storage capacity increased with relative consistency as the average number of cows milked per day increased. Operations that had a daily milk pick-up averaged 854 gallons of storage capacity and 225 cows milked per day. The operations that had every other day milk pick-up averaged 1,094 gallons of storage capacity and 194 cows milked per day.

Housing

The most prevalent type of housing used was free stalls. Thirteen of 19 operators using only free stall barns reported having 11,800 square feet of space available per farm. Operators who used a free stall barn in combination with another barn type reduced the average square feet of free stall barn space per farm to 10,535 feet (Table 18). Nine operators used only loafing barns for housing dairy cows. The average amount of loafing barn space was 7,300 square feet per farm. This compared to 6,500 square feet of loafing barn space for the total number of loafing barns reported. Four operators used stanchion barns for the housing of dairy cows because they had no other facilities. However, three of these operators were in the process of building free stall barns. One operator used only stanchion barns for housing. Table 19 shows that eight per cent of all barns used for housing dairy cows were stanchion barns, 25 per cent were loafing barns, and 67 per cent were free stall barns.

Dry cow barns contained an average of 4,041 square feet as reported by 17 operators. Twenty-nine operators had an average of 4,269 square feet of space for calves and heifers. The average size holding lot for these dairy cows was 3,246 square feet. Aside from the holding lot, many operators had an exercise lot which averaged 12.5 acres.

TABLE 17

**Bulk Milk Tank Storage Capacity by Tank Size, Average
Cows Milked Daily, Average Storage Capacity Per Cow and
Frequency of Milk Pick-up on Large Dairy Operations,
West Virginia, 1970**

Range of Total Milk Storage	Farms Reporting	Average Cows Milked Per Day	Average Milk Storage Capacity Per Cow Per Day
Gallons	Number	Number	Gallons
Milk Picked Up Daily			
400	1	200	4.0
500-550	4	180	5.8
600-680	4	198	6.2
700-740	2	200	7.2
800-880	2	236	7.1
1,000-1,020	5	240	7.1
1,100	2	238	8.4
1,250	1	216	11.6
2,200	1	480	9.2
All Farms	22	225	7.0
Milk Picked Up Every Other Day			
650-660	2	176	4.3
800-815	3	198	3.0
900-950	2	174	3.3
1,000	5	178	5.6
1,150-1,200	3	170	6.0
1,275	1	250	5.1
1,800	1	260	6.9
2,500	1	296	8.4
All Farms	18	194	5.4

Bedding

Straw and sawdust were the principal bedding materials (Table 19). Straw accounted for 35 per cent of the bedding; sawdust accounted for 52 per cent; and miscellaneous bedding materials accounted for 13 per cent. Miscellaneous bedding included limestone rock, and the following combinations: corn cobs and

TABLE 18
Housing and Lot Facilities Available for Dairy Animals
on Large Dairy Operations, West Virginia, 1970

Kind of Facility	Farms Reporting	Average Per Farm	Average Per Cow
	Number	Square Feet	Square Feet
Buildings			
Free Stall Barn	20	10,535	69
Loafing Barn	20	6,500	51
Stanchion ¹	2	5,100	—
Dry Cow Barn	17	4,041	—
Heifer and Calf Barn	29	4,269	—
Holding Lot	28	3,246	37
All Farm Buildings	40	15,857	—
		Acres	Acres
Exercise Lot	23	12.5	.09

¹Due to the small number of farms reporting stanchion barns used as housing, the average number of square feet per stanchion barn per farm is distorted since one barn contained 70 stanchions and the other barn had only 39 stanchions.

TABLE 19
Kind of Bedding Used by Type of Barn on Large Dairy
Operations, West Virginia, 1970

Kind of Bedding	Type of Barn ¹			Per Cent of Total
	Stanchion	Loafing	Free Stalls	
	Number	Number	Number	
Straw	3	10	4	35
Sawdust	1	1	23	52
Miscellaneous ²		1	5	13
Per Cent of Total	8	25	67	100

¹Total number of barns do not equal 40 because some operations have more than one barn type.

²Miscellaneous bedding includes limestone rock and the following combinations: corn cobs and shavings, straw and sawdust, and corn cobs and straw.

shavings, straw and sawdust, and corn cobs and straw. Straw was used in three stanchion barns, 10 loafing barns, and four free stall barns. Sawdust was used in one stanchion barn, one loafing barn, and 23 free stall barns.

Silo Capacity

There were five types of silos:

1. upright
2. bunker
3. trench
4. cement slab
5. gas-tight

The 40 operators reported a total of 167 silos. The median of the total silo capacity per operation was 1,288 tons. Upright silos were the principal silage storing units (Table 20). No major shift toward the use of bunkers and trench silos was detected in this study.

Thirty-seven operators had a total of 138 upright silos with an average capacity of 299 tons per silo. Of these 37 operators, 56 per cent had only upright silos. Thirty-two operations had a total of 55 silage unloaders. Five operators reported having one bunker type silo each with an average capacity of 1,133 tons per silo. The trench silos averaged 442 tons per silo with 12 operators using a total of 18 trench silos. One operator indicated that a concrete slab was the fastest and most economical method by which to handle his silage. This concrete slab held about 300 tons of silage. There were very few gas-tight silos

TABLE 20
Number of Silos and Capacity by Type for Large
Dairy Operations, West Virginia, 1970

Type	Farms Reporting	Total	Silo	
			Average	
			Per Farm	Per Silo
	Number	Number	Number	Tons
Upright	37	138	3.7	299
Bunker	5	5	1.0	1,133
Trench	12	18	1.5	442
Concrete Slab	1	1	1.0	300
Gas-tight	4	5	1.2	935
All farms	40	167	4.2	358

due principally to the high cost. Four operators had a total of five air-tight upright silos that averaged 935 tons of silage storage capacity per silo. Silo storage space averaged 11.25 tons per dairy cow and replacement stock.

POWER AND EQUIPMENT

Tractors

Using the correct size tractor is important to a dairy operator. Field choppers and other large machinery require large tractors to operate efficiently, whereas smaller tractors perform smaller jobs more economically. The 40 operators owned a total of 205 tractors ranging from 11-111 horsepower per tractor. Fifty-one per cent of these tractors had a drawbar horsepower rating ranging from 30-49.9 horsepower. There was a noticeable decrease in tractor numbers beyond the 40-49.9 horsepower class range. The 50-59.9 horsepower range included 10 per cent of the tractors and the 70 or more horsepower class included 11 per cent. Five per cent of the tractors were in the 60-69.9 horsepower class, and five per cent of them had less than 20 horsepower. The remaining 18 per cent were within the 20-29.9 horsepower class.

Sixty-eight per cent of the tractors were purchased new by the present owner. Division of horsepower rating into class groups as shown in Table 21 indicated that the number of tractors purchased new for any one group ranged from a low of two out of 11 tractors in the less than 20 horsepower group and a high of 20 out of 22 tractors in the 70 or more horsepower group. This percentage increased from the less than 20 horsepower group through the 40-50 horsepower group where 34 of 41 tractors were purchased new. The proportion of tractors purchased new dropped slightly for the 50 to 59.9 and 60 to 69.9 horsepower groups.

The same relationships existed for the number of tractors five years of age or less as for tractors bought new, except that the percentages were lower for the smaller tractors and no tractor in the less than 20 horsepower group was under 5 years of age. A total of 104 of the 205 tractors were five years of age or less.

Trucks

Thirty-nine operations reported having 111 trucks ranging from pickups¹² to three-ton trucks (Table 22). Pickups, 1 1/2 ton, and two-ton trucks made up 87 per cent of trucks used on the dairy operations. Pickups were used mainly for running errands. The larger trucks were used for hauling cattle, silage, and lime.

¹²Trucks with ratings of 1/2 and 3/4 ton and metal box beds were classified as "pickup" trucks.

TABLE 21
Number of Tractors, New Purchases, and Age by Drawbar Horsepower Rating on
Large Dairy Operations, West Virginia, 1970¹

Tractor Size	Farms Reporting	Maximum Per Farm	Total Tractors	Total Tractors	Purchased New	Machine Age 5 Years or Less
Horsepower	Number	Number	Number	Per Cent	Number	Number
Less than 20.0	7	2	11	5	2	—
20-29.9	24	4	37	18	18	6
30-39.9	32	4	64	31	41	24
40-49.9	27	4	41	20	34	33
50-59.9	16	2	19	10	15	14
60-69.9	11	1	11	5	7	7
70 or more	17	2	22	11	20	20
Total	40	10	205	100	137	104

¹ Drawbar horsepower rating was selected as the most meaningful expression of horsepower efficiency upon consultation and advice of the Committee of Agricultural Engineering, West Virginia University.

TABLE 22
Numbers of Trucks, New Purchases, and Age by Tonnage Ratings on
Large Dairy Operations, West Virginia, 1970

Truck Rating	Farms Reporting	Maximum Per Farm	Total Trucks	Total Trucks	Purchased New	Machine Age 5 Years or Less
Tonnage	Number	Number	Number	Per Cent	Number	Number
1/2	18	2	22	20	17	16
3/4	13	3	18	16	14	7
1	9	2	10	9	2	4
1 1/2	15	3	26	23	13	4
2	19	3	30	28	12	12
2 1/2	3	2	4	3	2	1
3	1	1	1	1	1	0
Total	39	9	111	100	61	44

Thirty-one of the 40 pickups were purchased new by the present owner, whereas only 13 of 26 of the 1 1/2-ton trucks and 12 of 30 of the two-ton trucks were purchased new. Sixteen of the 22 half-ton pickups and seven of the 18 three-quarter ton pickups were five years of age or less. A smaller number, four of 26 of the 1 1/2-ton and 12 out of 30 of the two-ton trucks, were five years of age or less. Of all 111 trucks, 61 were purchased new and 44 were five years of age or less.

Tillage Equipment

Plows were the only piece of machinery owned by all 40 individual operators (Table 23). These 40 operations had a total of 77 sets of plows. Of these, 40 per cent were three-bottom, 23 per cent were four-bottom, and 17 per cent were five-bottom plows. Thirty-nine operations had 64 disks and 10 operations had one rotary hoe each. Springtooth harrows were more plentiful than spiketooth harrows. Twenty operations had 32 springtooth harrows, while seven operations had eight spiketooth harrows. A total of 27 operations had 36 cultipackers and 45 cultivators. Fifty per cent or more of all tillage equipment was purchased new except for spiketooth harrows and cultipackers. Fifty per cent or more of the plows, disks, and springtooth harrows were five years old or less.

Hay Equipment

Nearly all operations had the necessary hay equipment needed. There was a total of 60 mowers and 39 balers on 38 operations (Table 23). Thirty-nine operations had 41 hay rakes. There was one hay conditioner and one mower-conditioner per operation on 27 and 16 operations, respectively. Three operations had hay driers. Sixty hay elevators were available on 37 operations. At least 65 per cent of all hay equipment was purchased new with at least 50 per cent of it, except hay driers, elevators, and rakes, five years of age or less.

Corn and Grain Equipment

Thirty-nine operators had a total of 48 field choppers and 40 corn planters (Table 23). There was a total of 32 corn sprayers on 30 operations. Twenty-seven operations had 46 silage blowers and 19 operations had 20 corn pickers.

A total of 18 grain elevators and 32 grain drills were reported on 15 and 31 operations, respectively. There was one combine per operation on 16 operations. At least 69 per cent of all corn and grain equipment was purchased new. Corn pickers, grain elevators, and grain drills were the oldest of the corn and grain equipment. Only half of the combines were five years of age or less.

Manure Handling Equipment

There was a total of 60 manure spreaders on 40 operations (Table 23). At least 65 per cent of these were purchased new and were five years of age or less. Manure loading was done by 38 end loaders on 33 operations and by nine manure loaders on six operations. At least 50 per cent of all manure loading equipment was purchased new and was five years of age or less. Five operations used a gutter cleaner and seven operations used two liquid manure storage tanks per operation. All liquid manure storage tanks were purchased new and were five years of age or less.

Wagons

Flat bed and silage wagons were the most common types of wagon on these dairy operations. Thirty-seven operations had a total of 102 flat bed wagons and 94 silage wagons (Table 23). There were only nine grain wagons on four operations and 19 "throw bale" wagons on five operations. A majority of all wagons were purchased new. Only flat bed wagons were generally over five years old.

Feed Equipment

Twenty-two operators had their own feed mixer and grinder (Table 23). As was stated previously, 27 operators mixed their feed. Of those mixing their own feed, only five operators hired their feed mixing and grinding done. Thirty operators stored their feed in commercial bulk feed bins. These bulk feed bins average seven tons of storage capacity per bin. The other operators used homemade bins which were usually converted barn attics.

OPERATIONAL DEVELOPMENT AND ORGANIZATION

A comprehensive description of the large dairy operations in West Virginia requires information about their past growth and anticipated future growth.

Development

Twenty-six of the 40 operations studied were started between 1940 and 1969 (Table 24). Twelve of these 26 began in the 1940's and 10 began in the 1960's. Nine of the 40 operations started during the decade beginning in 1930. Two operations started before 1920 and three operations started during the decade of 1920 were still under continuous management in 1970. The older operations tended to be located along the Ohio River Valley. The younger operations were in the Greenbrier Valley in southeastern West Virginia. The large concentration of dairy operations in Jefferson and Berkeley counties began operation in the period, 1940-1959.

TABLE 23

Machinery and Equipment, Numbers, New Purchases, and Age by Kind of Equipment on
Large Dairy Operations, West Virginia, 1970

Kind	Farms Reporting	Machinery and Equipment		Purchased		Machine Age 5 Years or Less
		Total	Range Per Farm	New		
Plow	40	77	1-3	57		44
Disk	39	64	1-7	43		34
Springtooth Harrow	20	32	1-7	20		18
Spiketooth Harrow	7	8	1-2	0		0
Rotary Hoe	10	10	1	6		4
Cultipacker	27	36	1-6	12		9
Cultivator	27	45	1-6	29		12
Hay Mower	38	60	1-6	42		33
Hay Rake	39	41	1-2	35		19
Hay Conditioner	27	27	1	22		15
Hay Baler	38	39	1-2	33		20
Mower-Conditioner	16	16	1	16		16
Hay Drier	3	3	1	2		0
Field Chopper	39	48	1-3	42		39
Corn Planter	39	40	1-2	35		34
Corn Sprayer	30	32	1-2			
Silage Blower	27	46	1-2	43		32
Corn Picker	19	20	1-2	15		4

Hay Elevator	37	60	1-4	39	18
Grain Elevator	15	18	1-2	14	9
Silage Blower	27	46	1-2	43	32
Corn Picker	19	20	1-2	15	4
Hay Elevator	37	60	1-4	39	18
Grain Elevator	15	18	1-2	14	9
Grain Drill	31	32	1-2	22	12
Combine	16	16	1	11	8
Lime Spreader	7	9	1-2	7	5
Fertilizer Spreader	21	22	1-2	14	14
Manure Spreader	40	60	1-3	53	39
End Loader	33	38	1-3	26	23
Manure Loader	6	9	1-2	8	5
Gutter Cleaner	5	5	1	4	2
Liquid Manure Storage Tank	7	14	2	5	5
Feed Mixer and Grinder	22	23	1-2	16	15
Grain Drier	10	14	1-4	9	11
Bulk Feed Bin	30	48	1-6	32	20
Bulk Grain Bin	9	22	1-5	21	19
Brush Hog	29	32	1-2	27	18
Flat Bed Wagon	37	102	1-6	64	27
Grain Wagon	4	9	2-3	7	5
Silage Wagon	37	94	1-5	72	63
Throw Bale Wagon	5	19	3-6	19	19

TABLE 24
Decade of Entry, Original Type of Milking System Used, Beginning Cow Numbers, and
Acres of Land Compared to 1970 Data for Large Dairy Operations in West Virginia

Decade Started	Original Type of Milking System Used				Beginning			1970		
	Began Dairy Farming	Hand	Pail	Pipe- line	Average Cows Per Farm	Number	Average Farm Size	Average Cows Per Farm	Number	Average Farm Size
1910-1919	2	2	—	—	15	15	195	117	117	705
1920-1929	3	3	—	—	18	18	733	180	180	856
1930-1939	9	8	1	—	25	25	276	124	124	647
1940-1949	12	8	4	—	18	18	242	157	157	981
1950-1959	4	—	3	1	28	28	276	111	111	820
1960-1969	10	—	.2	8	59	59	423	118	118	685

The reasons that influenced these men to become dairy operators can be classified into four categories:

1. steady income
2. good returns
3. liked dairying and therefore wanted to be a dairyman
4. previously had resources useable for dairying

Eighty-eight per cent of the dairy operators fell into the first three categories. Twelve operators said that good returns influenced them and eight operators reported the influence of having a steady income and resources available. Fifteen operators reported they always wanted to be dairymen because they either liked dairying, dairying was all they knew, or phases of dairying were learned and liked through Vocational Agricultural training in high school.

A majority of these dairy operators started in the dairying business by one of two methods. Eighteen operators bought a farm on which they started milking cows. Another 16 of the operators had farms and just gradually accumulated enough cows to start selling milk. The remaining six operators either inherited a farm or bought a dairy. Three-fourths of the operators added cows each year to obtain a 100 or more cow operation. One-fourth of the operators started into business milking a relatively large number of cows.

The type of milking system first used by these operators depended upon the year in which they began dairying (Table 24). Eight of the 12 operators who began dairying in the decade 1940-1949 were the last to start their operations using hand milking. A total of 21 operations began dairying with hand milking. Ten operations used the pail milking system. Among these dairymen, the first pail system was used in the decade 1930-1939 and there were two operations that started dairying with the pail system in the decade of 1960-1969. The first pipeline system came into use on these operations in the decade 1950-1959. Sixty-four per cent of the operators that started dairying after 1950 used the pipeline system first in their operations.

The average number of cows increased with each beginning operation for each 10-year period from the decade 1910-1919 to the decade of 1960-1969, except those that began during the decade 1940-1949. However, the largest group of dairy operators began dairying in the decade 1940-1949. The smallest beginning number of cows for an operation started between 1940-1949 was 15 and the largest beginning number was 59 for the same period. The two extremes occurred on operations that were started in the decades 1910-1919 and 1960-1969, respectively. The operations that started dairying in the decade 1920-1929 and 1940-1949 had an average of 18 cows per operation. There were 25 and 28 cows on the operations that were started in the decades 1930-1939 and 1950-1959. The number of cows per operation on these same operations in 1970 showed a more erratic relationship. Comparing the beginning number of cows with the present number of cows shows that there was a range of increase

from 2-10 times the beginning number of cows per operation. The extremes occurred on operations that started dairying in the decades 1960-1969 and 1920-1929, respectively. There was an eight-fold increase for the operations beginning in the decades of 1910-1919 and 1940-1949. Operations that were begun in the decade 1930-1939 had a six-fold increase while the operations beginning in the decade 1950-1959 had four-fold increases.

The growth of herd size for four time periods is reported in Table 25. These time periods included the year the operations were started, the years 1960 and 1970, and an estimation by the operators about herd size in 1980. The most frequent beginning herd size reported was from 10 to 19 cows. Herds with 1 to 9 cows and herds with 100-124 cows represented the range for the size of beginning herds. In 1960 the most frequent herd size was 50 to 74 cows. The smallest herd in 1960 had 20 cows, while the largest herd for that year had 150 cows. In 1970, when this study was conducted, the most frequent herd size was from 100-124 cows. Two operations had herds of 300 or more cows. These operators had been at their 1970 level of 100 or more cows for an average of

TABLE 25
Number of Operations by Beginning, 1960, 1970,
and Estimated 1980 Herd Sizes for Large Dairy
Operations, West Virginia, 1970

Herd Size	Operations at Different Time Intervals			
	Actual			Estimated 1980
	Beginning	1960	1970	
1-9	3	—	—	—
10-19	12	—	—	—
20-29	9	3	—	—
30-39	4	2	—	—
40-49	1	5	—	—
50-74	6	17	—	—
75-99	4	—	—	—
100-124	1	2	22	12
125-149	—	2	8	4
150-199	—	1	7	8
200-249	—	—	1	6
250-299	—	—	—	2
300+	—	—	2	4
Not Dairying	—	8	—	4

three years. The 1970 level of cow numbers had been first obtained on these operations from one to 15 years earlier. The mode of time required to reach this level was two years. Operators were asked what size herd they anticipated by 1980. The most frequently mentioned size remained the same as in 1970. However, a large number of operators indicated the desire to milk 200 or more cows, thus, suggesting a possible continued growth in size of these dairy operations in West Virginia. Only four operators indicated they did not plan to be dairying in 1980.

Farm size, in terms of acreage, increased within a range from two or four times the beginning acreage except for the dairy operations that were begun in the decades 1920-1929 and 1960-1969 (Table 24). The acreage of operations started in these two decades did not increase as much as the acreage increase for the operations started in the other decades.

Physical Changes and Limitation

Many changes accompanied the growth in herd size. Operators were asked to indicate the biggest change they had made in physical facilities since being in the dairy business. The switch from a stanchion to a parlor milking system was the most frequent reply. Thirty-eight per cent of the operators gave this answer. Twenty-five per cent of the operators indicated that loafing barns and free stalls created the biggest change in their operation. Another 25 per cent indicated the biggest change as being silos and the feeding system. There were two operators that had completely changed their whole physical facility set up since starting into the dairy business. Another two operators thought mechanization of most phases of dairying was the biggest change. A liquid manure system was the biggest change for one operator. All of these changes contributed to ease of operation and reduction of labor.

Constant changes are needed because, even with the changes already made on these operations, labor was the most limiting factor. Presented in order, the most limiting factors were labor, land, capital, and management. Some operators believed they had a combination of factors that limited their operation. These included land and labor, management and labor, and capital and labor. However, two operators said they had no limiting factors other than their own desires.

Most of the dairy operators believed continued improvement and change was needed. A wide variety of future needs was listed. Only two operators indicated no future project; however, these same two operators had just completed major projects. As mentioned before, four operators indicated they would probably go out of the dairy business. The most needed projects included more silos, milking parlors, free stalls, and new feeding systems. The second order of projects included maternity pens, calf barns, and greater efficiency with present system. Two operators felt future plans would have to include a complete overhaul of their systems.

Labor

Typically, the labor force on a large dairy consists of an owner or operator, family members, and two or sometimes three full-time hired men (Table 26). The extremes of the labor force in this study consisted of a completely family operated dairy to a dairy hiring nine full-time men. Twenty-four operations used job specialization. Specialization occurred mostly with the milking phase of the operation. However, one operator had a man to repair machinery. There was very little custom work done by these large dairy operators for other farmers. Three operators did perform custom work an average of 11 days per year. These jobs included corn shelling and combining, corn planting and spraying, and baling and corn picking. In contrast, there was more custom work hired. Eighteen operators had an average of five days of custom work done for them. The work included corn shelling, picking, combining, and fertilizer spreading.

The operations averaged 4.7 man equivalents per operation, with an average of 29 cows per man equivalent and 357,433 pounds of milk per man equivalent per year. Every operator represented an average of 0.98 man equivalents, as a result of some operators being over 60 years of age. Thirty-six operations used family labor representing one man equivalent per operation. Full-time hired workers averaged 2.76 man equivalents per operation.

TABLE 26
Total and Per Farm Man Equivalents and Cows Per Man
Equivalent by Worker Categories on Large Dairy
Operations, West Virginia, 1970

Worker	Farms	Man Equivalents ¹	
		Total	Per Farm
Operator ²	40	39.2	0.98
Other Family	36	26.1	1.00
Full-time	34	94.2	2.76
Regular Part-time	18	10.5	0.58
Occasional	18	6.8	0.38
Total	40	187.3	4.68

¹See footnote 2, Table 1.

²There were 8 cases of partnerships, co-owners, and/or co-operators. In each of these multiple owner-manager operations, there were only 2 persons involved; one was counted as the operator, and the other was counted as other family or full-time workers for this report. There were 5 corporations that were handled in the same manner.

The full-time hired men, whose average age was 37, worked an average of six days a week. Some operations alternated the work between a five- and seven-day week. The schedule differed, but most operations managed to give the full-time hired help time off. A few operators indicated a seven-day week for their full-time men.

Only 18 operations hired regular part-time workers and only 18 operations hired occasional help. Generally, the occasional help was hired for the hay season. This help consisted of high school boys who were paid an average of \$1.25 per hour. These boys were hired an average of 14 days a year.

The operators were relatively young and well educated; the average age was 44 years. Forty per cent of them had a high school education and another 40 per cent had attended or graduated from college (Table 27).

Productive Man-Work Units

A productive man-work unit (P.M.W.U.) is the amount of work usually done by a man in a 10-hour day on crops and livestock.¹³ For example, large dairy operators average 80 hours or eight days of work for each dairy cow per year. Productive man-work units¹⁴ can be used to estimate labor needs. Considering all cropland and livestock on these operations, there were 1,917 units per farm ranging from a low of 1,069 to a high of 4,048 (Table 28). For all operations, there was an average of 412 units per man equivalent.

Separating the total units for total livestock and total cropland, approximately two-thirds (1,265) of the units were involved with cropland. This same fractional separation occurred for units per man equivalent. The range of units per farm for livestock and cropland was 843 to 2,881 units and 220 to 1,785 units, respectively.

Dairy cows were responsible for 1,064 units per operation and 229 units per man equivalent. The range per farm for these units was 800 to 2,600. Other dairy livestock which includes calves, heifers, and bulls required an average of 159 units per farm with a range of 43 to 375 units per operation. Thirty-four units per man equivalent were involved with other dairy livestock. Those four operations raising non-dairy livestock had a relatively large number of units per operation.

The chief crops, corn grain and corn silage, had approximately the same number of units per farm and per man equivalent. The main difference occurred in the range. For corn grain, the range of units per farm was 75 to 621 as compared to a range of 78 to 1,080 for corn silage. Small grains were combined

¹³See footnote 2, Table 1.

¹⁴Throughout the remainder of the discussion on productive man-work unit(s), (P.M.W.U.), an abbreviated form will be utilized and referred to as units.

TABLE 27
Years of Schooling Completed by Dairy Operators on
Large Dairy Operations, West Virginia, 1970

Education Completed	Dairy Operators	
	Number	Percentage
5th grade	1	2.5
6-9th grade	5	12.5
10th grade	1	2.5
11th grade	1	2.5
12th grade	16	40.0
1 year college	5	12.5
2 years college	2	5.0
3 years college	1	2.5
4 years college	8	20.0

and they had an average of 93 units per farm and 21 units per man equivalent. The range of units involved with small grains was 14 to 307. On the operations that raised small grains for silage, there was an average of 82 units per farm. The range was from 8 to 411 units. Hay, the second most important crop in acreage on these operations, averaged 116 units per farm ranging from 27 to 364 units per farm. There were 25 units per man equivalent for the hay grown on these operations.

Credit and Investment

The unavailability of money was not reported as a big problem. Thirty-six operators said that credit was not hard to obtain. Despite the fact that this study was conducted in the spring of 1970 when interest rates were relatively high, most operators replied that the only drawback to obtaining credit was the willingness to pay the high interest rates. Two operators indicated that they did not use credit and were therefore unfamiliar with availability.

The most used sources of credit were the banks. The remaining credit sources, listed in order of use, were.

1. Production Credit Association
2. Farmers Home Administration
3. Federal Land Bank Associations
4. Insurance Companies

The types of credit considered in this study were real estate, chattel, short-term, and miscellaneous. At the time this study was conducted, 18 operators had real

TABLE 28
Productive Man-Work Units (P.M.W.U.) by Enterprises on Large Dairy Operations,
West Virginia, 1970

Enterprise	P.M.W.U.				Per Man Equivalent
	Farms	Total	Per Farm	Range	
Total Livestock P.M.W.U.	40	50,615	1,265	843-2881	272
Dairy Cows	40	42,560	1,064	800-2600	229
Other Dairy	40	6,372	159	43-372	34
Non-Dairy	4	1,683	421	90-912	80
Total Cropland P.M.W.U. ¹	40	26,063	652	220-1785	140
Corn Grain	26	6,595	254	75-621	57
Corn Silage	40	10,437	261	78-1080	56
Small Grains	22	2,051	93	14-307	21
Small Grain Silage	15	1,236	82	8-411	18
Hay	39	4,626	116	27-364	25
Grand Total	40	76,678	1,917	1069-4048	412

¹There were 1,118 P.M.W.U.'s involving 918 P.M.W.U.'s for orchards and 200 P.M.W.U.'s for soybeans included in the total cropland P.M.W.U. that are not shown individually.

estate loans and 13 had chattel loans (Table 29). There were 17 operators with short-term loans and 19 with a combination of other types of loans. Most of the miscellaneous loans were with banks. Also banks and the Production Credit Association were the sources for most short-term loans. Chattel loans were with Farmers Home Administration, banks, and Production Credit Association. The previously mentioned credit sources, plus individuals, the Federal Land Bank Associations, and insurance companies were the sources for real estate loans.

The amount of indebtedness on all phases of these dairy operations ranged from less than \$10,000 to \$150,000 or more (Table 30). Eight operators indicated no loans against their operations. Twenty-seven of 32 operators borrowing had loans amounting to between \$10,000 and \$100,000. Ten of these twenty-seven operators had loans of between \$25,000 and \$49,000. Five operations had loans ranging between \$10,000 to \$24,000 and another group of five had loans between \$75,000 to \$99,000. The remaining seven operators had loans of between \$50,000 and \$74,000.

Dairying is big agricultural business and large amounts of assets are required. Land, cattle, machinery, and buildings combine to constitute the total assets on these dairy operations. Total asset values reported by the operators ranged from \$100,000 to over \$500,000. Fifteen operators reported assets of between \$200,000 and \$299,999. Assets of between \$300,000 and \$499,999 were reported by nine operators while five operators reported assets of \$500,000 or more. The remaining seven operators that reported had assets valued at between \$100,000 and \$199,999. Four operators did not provide data.

TABLE 29
Credit Sources for Large Dairy Operations by
Type of Credit, West Virginia, 1970

Source	Type of Credit			
	Real Estate	Chattel	Short-Term	Other
None	22	27	23	21
Individuals	3	—	1	1
Farmers Home Administration	3	4	2	—
Federal Land Bank	6	—	—	—
Insurance Companies	1	—	—	—
Bank	5	5	9	18
Production Credit Association	—	4	5	—
Total	18	13	17	19

TABLE 30

Assets to Liability Position Reported by Large Dairy Operations,
West Virginia, 1970

Assets	Liabilities (\$1,000's)							Row Totals
	None	Less than 10	10-24	25-49	50-74	75-99	100-149	150 or more
No Response	1	2	1	—	—	—	—	—
\$100,000-124,999	—	—	—	2	—	—	—	—
\$125,000-149,999	—	—	—	—	1	—	—	—
\$150,000-174,999	—	—	1	—	—	1	—	—
\$175,000-199,999	—	—	—	1	—	1	—	—
\$200,000-249,999	2	—	1	—	2	1	1	—
\$250,000-299,999	1	—	1	3	2	1	—	—
\$300,000-349,999	2	—	—	1	—	1	—	—
\$350,000-399,999	1	—	—	2	—	—	1	—
\$400,000-499,999	—	—	—	—	1	—	—	—
\$500,000 or more	1	—	1	1	1	—	—	1
Column Total	8	2	5	10	7	5	2	1
								40

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